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MANAGEMENT OF APHIDS ON CANOLA (*BRASSICA NAPUS* L.) THROUGH CULTURAL PRACTICES

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ABSTRACT

Aphids are considered as major menace in limiting the crop yields. Keeping in view the losses caused by aphids, the present study was conducted to investigate comparative effect of different companion crops viz., barley, berseem, lucerne, wheat, maize, fennel seed, onion and garlic on aphid population in canola sown as border and intercrop. Results showed that minimum aphids population (46.00 and 49.50 aphids plant^{-1}) was observed in garlic sown as border and intercrop with canola and gave an enhanced grain yield of 1796.30 Kgha^{-1} and 2222.22 Kgha^{-1}, respectively., Whereas canola plots with barley sown as border and intercrop showed significantly higher numbers of aphids (299.67 and 299.83 aphidsplant^{-1}) with a lower grain yield of canola 602.42 Kgha^{-1} and 648.14 Kgha^{-1}, respectively. While canola alone produced 740.75 and 787.02 Kgha^{-1} harboring 299.17 and 243.17 aphids plant^{-1}, respectively in border and intercrop. It is suggested that the aphid infestation can be minimized by the use of companion crops like garlic, onion and fennel seeds.

Keywords: Aphid, Canola, Companion crops, cultural practices

INTRODUCTION

Canola oil has supreme importance in human health with lesser levels of glucosinolates and erucic acid as compared to other oilseed crops (Abbas *et al*., 2017). In order to reduce import bill of edible oil (Ahmad *et al*., 2013), increase in acreage and production of oilseed crops especially canola (*Brassica napus*), a popular oil seed in Pakistan, has been witnessed. Canola has potential oil contents of 44-46% in addition to being used as fodder with 38-40% protein contents. Canola is cultivated on 0.207 acres annually in Punjab and Sindh (Anonymous, 2015). The factors responsible for low average yield (700-900 Kgha^{-1}) of canola in Pakistan include insect pests particularly aphids, which has become very important because of its considerable losses to the crop (Ahmad*, et al*., 2013; Anonymous, 2015;). Aphids harm canola crop not only by simple feeding with honeydew formation but also by transmitting viral diseases (Berlandier *et al*., 2010). In severe cases, losses may increase more than 75% of the total crop potential (Abbas *et al*., 2012). The pesticide use is most common among farmers for the control of aphids (Akbar *et al*.2016). The residual effect of chemicals, resulting into environment degradation and human health hazard, demands alternative management of aphids (Hill, 1989)**.**

Farming communities never bother to minimize ill effects of insecticides by adopting non chemical control measure like cultural practices. The cultural practices; such as sowing date, different methods of crop planting, plant spacing and plant population/intensity, intercropping, crop rotation, are ancient and traditional farming practice to enhance yield of crop. Although these methods have significant impact in reducing the insect pests but never explored in true words and spirit. It is established fact that diversified field or crop harbored the low pest attack by hiding the target crop or by attracting the more bio control agents in the vicinity (Norris *et al*., 2002). The role of cultural practice in managing insect pests in Pakistan had been appreciated by many workers (Tahir *et al*., 2003; Ahmad *et al* 2004; Saleha *et al*., 2009; Mamun *et al*., 2002; Sattar *et al*., 2013). Such cultural practices play important role to minimize the aphid infestation in a number of crops and contribute considerable increments in farm produce. Frank and Liburd (2005) advocated lower incidence of aphids in a more diverse cropping system and used some crops as living mulch which resulted in lower infestation of sucking insects. Mitchell *et al.* (2000) used collard greens

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(*Brassica oleracea* var. *acephala* L.) as a trap crop to suppress insect attack. Studies proved that intercropping can be an important method of crop production contributing significantly in enhancing crop productivity and reducing the losses caused by insect pests, diseases and weeds (Vandermeer, 1989). In Pakistan, scarcity of systematic studies on association of canola crop, cultural practices and aphid management is witnessed. Therefore present study was planned to investigate effect of different companion crops such as barley, berseem, lucerne, wheat, maize, fennel seed, onion and garlic on aphid population in canola.

MATERIALS AND METHODS

Basic Prerequisite

In this experiment canola was the crop to be protected from aphids whereas barley, berseem, lucerne (clover), wheat, maize, fennel seed, onion and garlic were used as companion crops. Two field plots separately were arranged for border and inter-crops. Canola alone was sown in separate plots which served as a control. The Canola variety "Rainbow" was sown at Experimental Farm of Nuclear Institute of Agriculture Tando Jam (Sindh) Pakistan, during November 2014 to March 2015.

Experimental Design

The experiment was designed under Randomized Complete Block Design with three replications with a plot size of (4m × 0.9m) 3.6 m^2 for each treatment. All the standard agronomic practices were carried out for raising the crop.

Observations and Data collection

Data about aphid incidence were observed after one month of sowing on fortnightly intervals during different growth stages up to the maturity of the crop. Aphids' population was estimated by observing 10 cm terminal portion of canola plant and the companion crop from randomly selected five plants of both crops in each treatment (Patel *et al.,* 2004) and mean aphids $plant^{-1}$ was worked out. The yield of canola in each treatment was also calculated.

Statistical Analysis

The data collected during experiment was analyzed by using one way ANOVA (Analysis of variance) and comparison of means was determined by LSD test through statistical software Statistix 8.1 .

RESULTS

Aphids' infestation on border crops along with canola

All the combinations showed different intensity of aphid attack on canola and border crops as shown in Table1. Canola plots bordered by barley supported the maximum aphids (299.67) $plant^{-1}$ with minimum yield while canola with garlic (46.00 aphids $plant^{-1}$), onion (55.67 aphids $plant^{-1}$) and fennel seed (76.33 aphids $plant^{-1}$) had significantly lowest aphids' population and correspondingly high yield of 1796.30, 1750.00 and 1620.36 Kg ha^{-1}. These results are significantly different from all other treatments including canola alone (740.75 Kg ha^{-1}) with high aphids (299.17 aphid $plant^{-1}$).

In case of border crops alone, no aphid was recorded on garlic, onion and fennel seed but different level of infestation was observed on berseem, wheat, clover and maize. The canola yield was highest (1796.30 Kg ha^{-1}) in plots where garlic was sown as border crop followed by onion (1750.00 Kg ha^{-1}) and fennel seed plot (1620.36 Kg ha^{-1}). However, gains in yield of canola from plots with these three border crops showed non-significant differences among each other but significantly different from all other combination including control (740.75 Kg ha^{-1}). The substantial losses of grain yield are saved by reducing the aphid incidence due to the presence of border crops, ultimately gave enhanced yield of canola. Obviously, significant yield losses by aphids were negatively co related with the population density of aphid.

Table1

Effects of companion border crops on the incidence of aphid population in canola crop.

Treatments	Aphids $plant^{-1}$		Yield	
	Canola	Border crop	(g/3.6 m^2)	(Kgha^{-1})
Canola (C)	299.17a	-------	266.67e	740.75
C+ Barley	299.67a	45.50a	216.67f	602.42
C+ Berseem	182.33bc	9.83b	316.67d	879.00
C+ Lucerne	134.50c	5.83bc	466.67c	1296.30
C+ Maize	200.17b	4.17cd	276.67de	768.52
C+ Wheat	182.50bc	7.50bc	306.67de	851.86
C+Fennel seed	76.33d	0.00d	583.33b	1620.36
C+ Garlic	46.00d	0.00d	646.67a	1796.30
C+ Onion	55.67d	0.00d	630.00a	1750.00
LSD	49.27	5.26	44.79	

Note: Means sharing same letters are not significantly different from each other at $p<0.05$.

Aphids' infestation on intercrop of canola

All plots of canola with intercrops showed different levels of aphids' infestation that were significantly different among themselves. These infestation levels ranged from 49.5 aphids plant^{-1} in garlic intercrop to 299.83 aphids plant^{-1} on barley intercrop except onion intercrop that showed non-significant differences with garlic 54.92 aphids plant^{-1} (Table 2). Garlic, onion and fennel seed intercropped with canola (in their separate plots) showed a repellent effect on aphids' infestation throughout the growing season. Aphid counts on canola with fennel seed (96.75 plant^{-1}) were significantly different from other two repellant combinations. In case of companion crop maximum aphids were recorded on barley followed by maize (209.83), berseem (189.00), wheat (164.17) and clover (151.00), respectively. Whereas there was no aphid observed on garlic, onion and fennel seed during the growing season of crop. Table.2 showed that canola with garlic intercrop performed the best with minimum aphids (49.50 plant^{-1}) and enhanced yield (2222.22 Kg ha^{-1}). It was significantly different from all other plots with intercrops. In case of barley intercrop the lowest yield (648.14 Kg ha^{-1}) with highest aphid number (299.83 plant^{-1}) were recorded.

Table 2

Effects of inter cropping on the incidence of aphid population in canola crop.

Treatments	Aphids plant^{-1}		Yield	
	Canola	Border crop	(g/3.6 m^2)	(Kgha^{-1})
Canola	243.17b	----------	283.33 g	787.02
C+ Barley	299.83a	34.17a	233.33 h	648.14
C+ Berseem	189.00cd	9.67b	365.00 e	1013.89
C+ Lucerne	151.00e	7.67b	473.33 d	1314.58
C+ Maize	209.83c	9.83b	310.00 fg	861.11
C+ Wheat	164.17de	8.83b	353.33 ef	981.47
C+Fennel seed	96.75f	0.00c	663.33 c	1842.00
C+ Garlic	49.50g	0.00c	800.00 a	2222.22
C+ Onion	54.92g	0.00c	735.00 b	2041.66
LSD	27.95	3.27	48.92	

Nmeans sharing same letters are not significantly different from each other at $p<0.05$.

DISCUSSION

Severe aphid infestation results no grain formation in succulent crops like mustards. Nymphs and adults suck cell sap of mustard plant at early flowering, and continue damaging pod and seed formation, up to the maturity of crop (Hussain *et al.*, 2015).Today, advances in pest management program equipped farmers with many option to suppress insect pests including plant resistance, biological, behavioural mechanical and chemical control. Oileferous Brassica is a minor crop of the area and grown on marginal lands and farmers never afford an additional investment on management of aphids. For such crop cultural control seems the best approach to deal with the problem. Cultural practices are admired being simple and effective approach, easy to operate with minimum or no additional cost to growers (Awal *et al.,* 2006). Field diversification by one or the other way protect the target crop by hiding from herbivorous insects pest or by providing harborage and essential food material to predators or parasitoids, who after releasing and foraging manage the pests in the ecosystem. Aphid population is suppressed in diversified field as compared to the mono cropping (Gurr *et al.*, 2012). Sutrisna *et al.* (2005) reported 55 percent reduction in aphids (*Myzus persicae*) population by intercropping. Our results agree with the previous studies carried out by Kirtikar and Basu (1975) and Simmonds *et al*. (1992). They reported that garlic and onion had strong pungent effect against aphids and these served as an effective anti-feedant. Similarly, Singh and Kothari (1997) observed that fennel seed proved the best among local aromatic plant species intercropped with mustard in reducing the aphid infestation. The findings supported our study as he noted that the odorous biochemical properties of the companion plants play a vital role in masking the host plants and escaping the target plants. Wnuk (1998) concluded in a study that intercropping of Phacelia (Blue tansy) plants in broad bean field reduced aphids' incidence by encouraging the foraging of syrphid larvae. Matsumoto and Kotulai (2002) used African marigold for pest management by repellent role of thiopene. Khan and Pickett (2004) reported that intercropping gained popularity among farming community of East Africa to protect their crops from insect pests. Lavandero (2005) and Tylianakis *et al.* (2004) supported companion crops due to its positive effect on the spatial distribution of natural enemies in cropping area and its surroundings.

The finding of present work showed that the garlic, onion and fennel seed have repelled the aphids while the other crops like barley, maize, berseem, wheat and clover supported the aphids' feeding which resulted in the higher incidence of aphids on canola. Hence it is suggested that the aromatic crops like garlic, onion and fennel seed which have repellant properties must be used as border or intercrop for keeping the aphids' infestation at tolerable level to ensure better yields. This preliminary study showed a significant effect of border and intercrops on the aphids' infestation in canola. Reduction in aphids count was recorded in both cases either bordered or

intercropped with the canola. The border or intercrop may have distracted pest to other crops which could serves as alternate host. Our investigation may become a preamble to explore the potential role of companion crops for aphid management program in canola and other crops. Cultural methods to control insect pest is among the primary pest management tools of an IPM strategy. But their potential role to manage the insect pest needs careful planning and further explorations considering the pest behavior and effectiveness of the relative companion crops (Potting *et al.,* 2005; Sarker *et al.,* 2007; Mutiga *et al.,* 2010).

AUTHORS' CONTRIBUTION

Waseem Akbar being a principal author of the manuscript conceived the basic idea of research and wrote the manuscript. Muhammad Usman Asif, Muhammad Ismail contributed in planning and execution of the experiments in field also helped in statistical analysis of data. Moula Bux technically helped during field execution. Dr Raza Muhammad Memon supervised the experiment from initial planning till execution of experiment and reviewed the manuscript.

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